Declaration

I, Denis David Stevens of 5 John Crawford Crescent, Casey, Australian Capital Territory, 2913, Australia make the following declaration:

Background

I am a qualified Engineer with a Bachelor of Engineering and I received my first Engineering qualification in 1983. Moreover, I have more than 32 years of motorsport experience. I have been involved in rally racing since 1979 and am still currently active in the sport.

Description of particular application

Underbody protection for rally cars that compete on gravel surfaces.

Throughout my motorsport career I have observed many attempts to solve the problem of protecting the vulnerable mechanical and structural component of vehicles being used for rallying from high speed impact with the road surface, rocks and other debris encountered on the course. These conditions are nearly impossible to replicate in a laboratory.

The methods employed with varying degrees of success include structures made from steel, aluminium, titanium and composites including fiberglass, Kevlar and plywood.

Steel underbody protection is heavy and therefore, impacts on the overall vehicle performance. Aluminium and titanium underbody protection are lighter and therefore, more suitable for this purpose. All three metal solutions are difficult to manufacture in structures that fit conformally to the underbody surfaces consequentially these solutions are generally compromised plate structures.

Composites provide the ability to manufacture conformal underbody protection thereby allowing for structures that have both strength and lightness.

In early 1982 I began constructing vehicle components from composites and in 1992 I constructed my first fiberglass underbody protection. The structure was approximately 12mm thick and while it was lighter than any of the previous metal structures used on the rally cars it suffered catastrophic failure due to impacts with rocks. I did not forsake composites and proceeded to trial, at various times, Kevlar, plywood and other composite arrangements. Ongoing research into possible composite solutions included aluminium and paper honeycomb structures. Balsa wood/high impact foam cored composite structures and Fiberglass/Kevlar structures utilising laminated sheet aluminium. There is much industry literature pertaining to the various surface treatment requirements for the latter structures.

More recently I was introduced to the Elaco technology and proceeded to fabricate and trial 8mm

thick underbody protection in our current rally car. The underbody protection was tested on several rallies alongside a heavier aluminium structure on a sister car competing in the same events. The Elaco based underbody protection performed excellently in providing impact protection for the mechanical and structural components under the car. While the aluminium underbody protection provided adequate protection for the vehicle components it suffered severe deformation from the repeated impacts thereby reducing the clearance between the engine components and the protection. This had the potential to cause mechanical failure through rubbing on the underbody protection. The Elaco based underbody protection maintained its shape integrity throughout the trial.

Having trialed several alternative technologies to solve the problem of providing light weight, high impact resistant, underbody protection for rally cars over an extended time period I was surprised at the unexpected impact performance improvement achieved through the use of three dimensional expanded mesh in fiberglass composites particularly as similar fiberglass only structures 50% thicker had failed previous tests.

It is my experienced and considered opinion that the three dimensional nature of the mesh used in the Elaco technology translates the orthogonal surface impact loads into longitudinal loads within the composite structure. These longitudinal loads are distributed by the fibres in the composite fabric. Moreover, the spaces between the metal in the mesh provide a pathway for the resin in the composite to bond the fabrics on both sides of the mesh together thereby improving the ability to dissipate the orthogonal loads. Despite the various surface treatments designed to improve adhesion between the metal sheet and the composite resins, continuous or perforated sheet metal would not provide the required load dissipation.

Also having monitored industry literature on light weight impact resistant composites since 1992 I had not encountered the use of three dimensional expanded mesh until I was introduced to Elaco technologies therefore, in my opinion I would not consider the use of expanded mesh in composites to be obvious.

Denis Stevens
6 October 2011